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Economic Issues Surrounding the Viability of Short Line Railways in the Canadian Prairies

James Nolan, Mohammad Khakbazan, Richard Gray and Murray Fulton

Department of Agricultural Economics
University of Saskatchewan
51 Campus Dr., Saskatoon
S7N 5A8

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1 – INTRODUCTION

Railroading has been an important industry in the Prairie grain economy for well over a hundred years. The bulkiness of grain shipments and the need to ship exportable surpluses to port means that railroads have played an important role in the grain handling and transportation system (GHTS). Historically, western Canadian settlement patterns, competition between railways for shipments and government grants and subsidies led to the construction of an extensive network of rail connector segments, often referred to as branch lines.

Over time, general traffic on Prairie branch lines declined and many of these lines gradually began to handle grain traffic almost exclusively. The longevity of the branch line network in western Canada has been due primarily to long-term transportation policies related directly to grain movement. For the better part of the last century, the major railways were obliged (with few exceptions) to maintain their western rail networks to serve grain movement (Currie, 1967).

With the passage of the Canada Transportation Act (CTA) in 1987 through the amendments made in the 1995-96 CTA, Canadian Class I railroads were finally given freedom to abandon unprofitable branch lines and consolidate network operations. Since 1996, each railway has increasingly pursued rail line abandonment across the country, often drawing public ire at the speed and finality of their line abandonments (Estey, 1998). This railway reaction should not be surprising. Evidence from Class I railways in the United States indicates that giving railroads the ability to abandon low volume lines has been a large contributor towards moving the failing American rail industry into financial stability (Gallamore, 1999).

In Canada, the Prairie grain economy has been most affected by rail line abandonment. Grain producers have shouldered increasing transportation costs under the new regulations for grain movement, including abandonment. There is also strong evidence that producers have not retained their fair share of railway productivity gains due to abandonment obtained since the last CTA review in 1996 (Estey, 1998).

In an attempt to offset the social costs of abandonment and maintain rail service in communities most affected by the removal of rail lines and grain elevators, a number of interest groups have championed the idea that small (or short line) rail firms should be encouraged to set up operations on those branch lines that may still be viable. Furthermore, others advocate that a number of smaller railways operating from these branch lines offer the best method of encouraging more competition in the rail industry in western Canada (Government of Saskatchewan, 2000).

Given the continued policy debate on this issue, this report will describe and examine economic perspectives on the Prairie rail abandonment problem. Should current policies of rail line abandonment be stopped? Under what conditions will short line railways be viable? How do other grain transportation modes affect short line viability? We will employ both theoretical and empirical economic analysis to answer these questions and generate recommendations for transportation policy with respect to short line railways and abandonment.

In the next section, we examine issues of access. We introduce the reader to the bottleneck problem (and the hold-up problem that bottlenecks create) and its applicability to short line rail operations and their access to the main line. Then we examine the U.S. experience using rail industry data. This data shows that the vast majority of successful U.S. regional railways are configured to avoid potential hold-up problems with Class I railroads. The conclusion from the analysis in this study is that there are not many branch lines in western Canada that meet similar criterion.

In Section 4, we develop a simulation model of the grain handling and transportation system (GHTS) in western Canada. Using data from Saskatchewan, we show that with respect to economic efficiency, the existing regulatory policies towards railway abandonment for Prairie branch lines, which include a financial penalty to the railways for abandonment, approach a socially optimal configuration. The railways are willing to incur the penalty in many cases because they gain large economies when they can consolidate their operations into longer and more frequent train runs.

In order to examine other possible transportation policy reactions to rail line abandonment, Section 5 provides a short discussion on the increased use of trucking under branch line abandonment. We focus the discussion on a comparison of social costs to private costs and the socially efficient pricing of externalities. Section 5 also presents another simulation exercise that implements a policy of road pricing for the grain trucking industry. Under present abandonment policies, combined with projected grain elevator consolidations, we find that road prices set so as to maintain the existing road infrastructure in Saskatchewan will not induce substantial behavioral changes among producers. Producers will continue to use trucks intensively to move their grain to elevators if there are no other transport alternatives. Furthermore, such a road pricing policy will create very small benefits to society in proportion to total grain transportation costs, as well as create significant costs for producers.

The main conclusions of the research are as follows:

1. Under the existing CTA, there are strong incentives for the abandonment of branch lines.

2. The abandonment of the majority of the branch lines in the Prairie region is likely to result in overall cost savings for the entire GHTS.

3. The distribution of the benefits of branch line abandonment are not evenly distributed among the many parties in the GHTS. Generally, the railways receive the greatest share of the benefits, while producers and especially taxpayers actually incur a cost.

4. The taxation of trucking will not greatly improve overall efficiency much and will put an even greater financial burden on producers.

5. Short line rail operations have a role to play in maintaining rail service. However, given the rules established with the introduction of the CTA, short lines are captive to the Class I railways and will not financially thrive unless better access is guaranteed. Indeed, evidence from the U.S. strongly suggests that without access to more than one Class I railway, short line railways will simply not operate.

6. The abandonment of branch line railways is effectively an irreversible decision. Indeed, once the land is sold to individual land owners, the right of access to a corridor will be gone and the cost of regaining this access will be so large as to make the recreation of a corridor virtually impossible. As a consequence, considerable care must be given to making this decision.

The following recommendations emerge from the study.

Recommendation 1 - If short line railways are to be viable, better rail access provisions to main line railways are required than those currently available. The government of Saskatchewan should push for the development of a policy of regulated rail access for any individual seeking to operate a short line railway.

Recommendation 2 – One way of regulating rail access is to designate short line railways as "shippers" and then require that these shippers have access to the main line at the same rates and terms that are offered to elevator companies for designated (e.g., 50 or 100) car spots (after appropriately accounting for the cost of railcars). The government of Saskatchewan should push for this designation and requirement.

Recommendation 3 – In the event that a short line railway feels that the rate offered by the main line railway is unfair, the short line railway should be given the ability to call for an "efficient component pricing rule" or ECPR to be calculated and applied. As section 2 points out, the ECPR computes a regulated access fee for rail infrastructure that is both economically efficient and fair to the owner of the main line.

Recommendation 4 – The government should purchase all abandoned branch lines at their salvage value. The government should then use the methodology presented in Section 4 to decide which branch lines to retain and which ones to dispose of.

Recommendation 5 – The branch lines that are retained should be leased in perpetuity to regional transportation planning councils who will then manage these assets in the public interest. These regional councils could try to establish short line operations or could convert the lines and rights of way to other uses.

2 – Short Line Railways and Access

Introduction

The rail industry on the Prairies is highly concentrated. Two Class I railways, Canadian National (CN) and Canadian Pacific (CP), serve almost the entire region. The areas served by CN and CP are for the most part geographically distinct so that most shippers have transparent access to only one railway. In addition to facing a highly concentrated rail industry, grain shippers have few other options available when it comes to shipping grain for export. West coast ports are 600 to 1600 miles from grain production on the Canadian Prairies, making trucking a very expensive option. Exporting grain via the East Coast or Gulf ports requires trucking several hundred miles in addition to significant waterway costs. As a result of these facto .., the two major railways have the ability to act as bottlenecks in the GHTS.

In the jargon of network based industries, bottlenecks are those portions of a network where physical limitations to the allocation of capacity through or over the network are binding. The fact that capacity is binding creates a source of market power for the owner of the bottleneck. Under the present set of proposals for short line operators, bottlenecks for short line carriers will exist because these operators must invariably pass their freight through portions of the rail network owned by a Class I operator. Resolving the bottleneck issue for other railways is equivalent to resolving the hold-up problem (for a description of the hold-up problem, see below).

To eliminate bottlenecks, regulations must be adopted which limit the ability of Class I carriers to exercise market power for shipments originating from branch lines. Even in networks where entry has occurred at the fringes, if true bottlenecks are still present, then the firm holding the property right over the bottleneck can exercise monopoly power over those competitors who must use the bottleneck to provide service. This situation has led some authors to conclude that simple marginal or fringe competition in networks, of the sort encouraged by short line proponents, cannot be effective (White, 1999). Therefore, the type of competitive regulations which will be most effective are those that facilitate pass-through service for all rail operations. This implies short line railways need to be given the ability to negotiate full network access for their shipments.

In Canada, a series of access regulations are presently available to shippers. These include limited mandatory interswitching rules, a regulated rate setting mechanism for captive shippers called a competitive line rate (CLR) and an official dispute resolution mechanism known as final offer arbitration (FOA)

(Bonsor, 1995).[1] Even though these regulations have been used a number of times since their introduction in the National Transportation Act of 1987, it is noteworthy that in recent years (since 1996) mandatory interswitches and CLRs have not been used at all (CTA, 2000); the former appear to be susceptible to collusive railway behavior by construction and the latter can be difficult for shippers to obtain.[2]

By definition, the existing competitive provisions are simply not available to a short-line rail operator. One easy way to remedy this situation is to change the regulation in the Canada Transport Act (CTA) from "shipper" to "any person", in a similar manner to that suggested by Justice Estey in Recommendation #8 (Estey, 1998). But it is our impression that the existing rail competition provisions may not be adequate to ensure a level playing field for short line operators. The only way to guarantee this is a policy of access in the rail industry.

Access to fixed, costly infrastructure is a crucial issue in many network industries, and rail is no exception. While access provisions can take many forms, we will focus this discussion on an access pricing solution that has been adopted in industries such as telephony, electricity and other rail systems around the world (Willig and Kessides, 1998). We suggest that provisions be added to the CTA to facilitate the computation of a regulated access fee for new rail entrants.

While offering the benefits of a market for short line rail operations and thus the possibility of improved rate competition for shippers, there are several practical difficulties with regulated access pricing. The most serious among these is that the access fees must be set appropriately. The term "appropriate" implies two things. First, the access price for track use must not be so excessive as to discourage those railways that might offer transportation service at lowest cost from providing that service. Second, the access price for the entrant firms must also fairly compensate the track owner for the use of existing infrastructure and

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[1] FOA was designed to help dissatisfied shippers. The present process is not very streamlined; the minimum time to a decision is 60 days. Nor is the process very effective for small firms or individuals because of legal costs. A second round of evidence submission (preceded by a full information exchange between the parties) before the final arbitration decision gives firms with large resources a chance to respond to the initial evidence presented against them. Furthermore, the final decision must side with one or the other of the submissions; there is presently no scope for intermediate settlement (Vercammen, 1996).

[2] With respect to mandatory interswitching, the shipper must first obtain a competing freight rate from an alternate carrier. Once a shipper/carrier agreement is made in this fashion, mandatory interswitching is the authority granted to the CTA to set the regulated freight rate over the tracks of the first carrier that the shipper is trying to bypass. For cases beyond the distance set for mandatory interswitching limits, the shipper may seek a CLR. Note that in order to obtain a CLR, a "captive" shipper (to be determined at the descretion of the CTA) must apply to the Agency to obtain a "competitive" freight rate over a railway. This rate is intended to appropriately compensate the first railway for the movement of the shipment to the other railway.

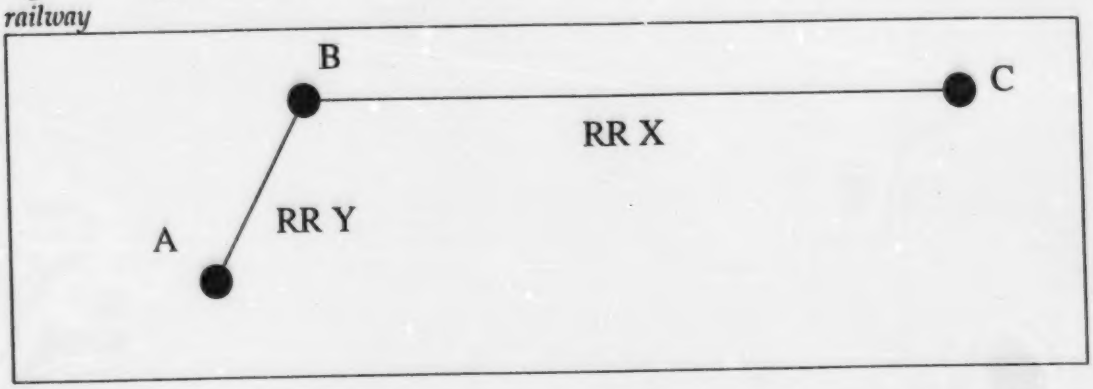
also provide incentives for the track owner to invest in the infrastructure and provide continued track maintenance. Without appropriate care in the price computation, there is a serious risk that the industry could collapse over time (Armstrong and Doyle, 1998). Finding a middle ground to satisfy these two basic conditions is the problem of regulated network access pricing.

The economic regulation literature offers methods for computing reasonable access fees to network infrastructure. An obvious method for computing an access fee is to look for other instances where access is granted and observe the fee that is charged in these cases. In the case of grain handling, main line railways routinely handle car spots that are assembled by grain handling companies at elevator points on the main line. These car spots are no different than those that might be assembled by a short line operator. Thus, the rate at which main line railways are willing to haul the car spots of the elevator companies can be used as a basis for an access fee for short line railways.

Where alternative rates are not present, a network access fee can be derived from the theory of regulatory economics. The regulatory pricing rule derived here is the so-called efficient component pricing rule or ECPR (Beshers, 2000). In the context of network industries, the ECPR is most often used to establish a price for access to that portion of a composite good (sometimes referred to as a "bottleneck") operated by a monopolist. Consider Figure 1. Assume a monopoly railway (railway X) provides service on the main line (i.e., between points B and C), and that a short line railway (railway Y) is considering supplying a service from point A to point B. Since the B-C segment is required to complete transportation between points A and C, BC is the bottleneck portion of any AC service.

A regulator can use the ECPR to compute an access fee for railway Y so that it can have its cargo (in this case grain) moved over the B-C segment by the monopoly railway (railway X). Let P_{AC} be the price (or rate) paid by a producer for shipping grain to port position (i.e., from A to C), let C_{AB} be the cost of using a short line railway to haul the grain from a local elevator (at A) to a switching point on the main line (at B), and let C_{BC} be the cost to the main line railway of hauling the grain over the main line.

Figure 1: A hypothetical short line railway and main line railway



Under the simple ECPR, a socially efficient charge for the B-C component would be equal to price of transport between A and C, minus the component cost of transportation between A and B, i.e., ECPR = $P_{BC} = P_{AC} - C_{AB}$ (Economides, 1997). One benefit of the ECPR is that if implemented, it guarantees that the most cost efficient firm will provide the service (Beshers, 2000). Since the short line railway will only operate if the ECPR is greater than the cost of supplying the short line service over segment A-B, the decision by the short line to operate means a gain in efficiency – the short line operator is effectively able to haul grain over the segment A-B at a cost less than what is incurred by farmers.

In addition to being efficient, the ECPR also compensates the bottleneck operator for both the direct costs of access due to entry as well as the opportunity costs associated with lost profits attributable to the entrant. The optimal access charge computes an incremental cost of providing access (the additional costs to the landlord railway attributable to the operations of the entrant) and adds to this a computation measuring the opportunity cost of providing access (Armstrong and Doyle, 1998). Indeed, the regulator can adjust the level of opportunity cost in order to compensate the host railway in whatever manner is deemed appropriate. All of these factors mean that the ECPR is an economically fair and sound pricing mechanism for access. At the very least, the ECPR provides a solid foundation upon which to build a regulated rail access regime.

While the ECPR is an economically fair and sound pricing mechanism, it is generally not the rate that a monopoly railroad would charge if it could determine the rate. The remainder of this section begins with a discussion of the hold-up problem, a theoretical concept that clearly illustrates why short lines subject to bottlenecks are unlikely to be financially viable. Empirical evidence of hold-up problems in the GHTS is then examined by a review of short line operations in the U.S.

The Hold-up Problem

The existence of rail bottlenecks, which creates market power, has important ramifications for society because of the so-called "hold-up problem." The hold-up problem has the following features (see Williamson (1983) for more details):

(a) The hold-up problem is created when one party (party A) is reluctant to make an investment because of the possibility that another party (party B) will act opportunistically and reap the rewards of the investment.

(b) The possibility of opportunistic behavior arises because party B is unable to credibly commit to an action that would leave party A with some of the benefits of the investment.

(c) Party B is unable to credibly commit because of the significant bargaining or market power that it possesses. As a result of this bargaining power, party B has both the incentive and the means to reap the rewards of the investment made by party A.

In the standard hold-up problem, the source of party B's bargaining power is the idiosyncratic nature of the investment made by party A. The more idiosyncratic the investment made by player A, the fewer other alternatives player A has for the use of the investment. The fewer the alternatives that player A has, the less bargaining power player A has and the greater are the benefits that can be obtained by party B. An important assumption defining the hold-up problem is that the players cannot sign a contract that will effectively govern their relationship in all possible instances. As a result of this contract incompleteness (perhaps because no contract is even possible), party B is able to renegotiate the contract and use its bargaining power.

On a more general basis, the hold-up problem arises whenever one party has significant bargaining or market power over another party. If markets are relatively competitive and firms have multiple choices as to with whom they can deal, the hold-up problem is small or non-existent. However, when a firm is limited in its dealings to only one party, the hold-up problem emerges. As a result, the potential for the hold-up problem is likely to exist in bottleneck situations.

The Hold-up Problem and Branch lines

There are at least two hold-up problems that emerge when considering rail network branch lines. One concerns the decisions made by grain companies as to where they will locate elevators, while the other concerns the operations of short line railroads.

Elevator location

For branch lines to be viable, both the railway and the grain handling companies have to make significant investments; the grain handling companies in elevators and the railways in track and facilities. Both of these investments are highly idiosyncratic. Indeed, these investments have very little other use. Because of the idiosyncratic nature of these investments, both parties are worried about opportunistic behaviour by the other party. A railway may be reluctant to invest in branch lines because of the fear that the grain companies may close facilities or fail to invest in upkeep, while the grain companies may be reluctant to invest in elevators on branch lines because the railway may abandon them.

Because of the lack of assurance on the part of both parties, neither set of investments may be undertaken. The result is that the branch lines are not maintained and elevators are located only on main lines. Note that this lack of investment may occur in situations where the existence of a branch line would be desirable to both parties. The lack of this investment is an example of a hold-up problem. The recent consolidation of the grain elevator system may be in part a reflection of this type of hold-up problem. The problem is also made worse because of the policy uncertainty that has existed for the last number of yeas. Uncertainty as to government policy on branch lines can make the hold-up problems worse.

Short line railways

Short line railways suffer from a number of problems that affect their viability. For instance, short lines may only be viable if they are able to capture the road costs that result from the lack of branch lines and the resulting extra truck traffic on roads. As will be clear from the evidence presented in the next sections, it will be difficult for private short lines to capture these costs without some form of government intervention.

Short line railways face additional difficulties due to the hold-up problem. Investment in a short line is an example of a highly idiosyncratic investment. Other than operating as a short line, this investment has no other alternative uses. The fact that short lines are highly idiosyncratic investments means that short lines typically have little bargaining power relative to the mainline railways, particularly if they have only one mainline railway with whom they deal. Note that when there is only one mainline railway through which mainline connections can be made, this mainline railway is a potential bottleneck.

Because of this lack of bargaining power, potential short line railway operators are likely to be reluctant to make the investment in a short line (Fulton and Gray, 1998). The result is that short line railways may not exist, even in situations where they would be economically desirable. One conclusion that emerges from

this analysis is that short lines are more likely to exist when they have multiple mainline railway companies with which to bargain. As shown elsewhere in the report, empirical evidence from the U.S. bears out this conclusion.

Alternatively, the hold-up or bottleneck problem means that successful short lines in Canada will be those that are effectively a vertically related part of a larger rail network. As Williamson points out, vertical relationships are a solution to the hold-up problem. In some cases, this vertical relationship may take the form of actual ownership; in other cases, the connection may be through a long-term strategic alliance. The desirable "competitive" aspect of short line existence is therefore mitigated by this vertical relationship to a larger network operator.

Short lines may lack bargaining power for other reasons. For instance, short lines are less likely to be feasible in situations where their market area is poorly defined and subject to erosion by other players. For instance, suppose a short line company has developed a line to railway X. If railway Y is in a position to pull grain off the short line (for instance, by using incentive rates), then the short line railway may see its bargaining power with railway X reduced, since the short line cannot provide a guarantee that it will supply a fixed amount of grain every year. One conclusion that emerges from this observation is that short lines are more likely to be economically viable if they have a clearly defined area from which they can draw grain.

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3 – CHARACTERISTICS OF SHORT LINE RAIL IN NORTH AMERICA

Introduction

The success of smaller rail companies in the United States is often cited as reason to encourage the operation of short lines north of the border. Considering the on-going process of discontinuance or transfer of large portions of low-volume track by both Class I rail firms in Canada, a number of interested groups have placed themselves in a position such that they might own and operate branch line railways to serve their own particular needs.

The characteristics of privately-owned short lines in the United States are different than those in Canada. As a consequence, the successes in the U.S. cannot be readily replicated north of the border without changes in rail regulation. The difference in the two countries stems from the fact that the majority of proposed short line rail routes in Canada will necessarily be captive to a single main line railroad for access to the rest of the North American rail network. Successful short lines in the United States are not captive in this manner. This finding raises doubt about the viability of a short line rail industry in Canada.

The Evolution of Short Line Rail in the United States

The Staggers Act of 1980 changed the policy landscape for American rail. Not only were rates and services de-regulated, but provisions were made for new firms to provide specialized services in the industry. The traditional view of the cost structure of vertically integrated railways was that railways would only operate as a monopoly. De-regulation brought new perspectives about the organizational structure and interactions between firms in the industry. One consequence of these changes was the emergence of the short line railroad (Jennings, 1996).

To draw comparisons between the experience of short lines in the U.S. and Canada, it is useful to define some railway terminology. The following two distinct classes of short line rail firm have evolved in the U.S. since rail de-regulation:

(a) *Regional carriers*. Regional carriers are non-Class I linehaul, freight railroads which operate at least 350 miles of railroad and/or earn at least $40 million in revenue.

(b) Local Railroads. These include freight railroads that are not Class I nor regional carriers. Thus, locals operate under 350 miles of road and earn less than $40 million annually. By service, local railroads can be further subdivided into: (i) local linehaul carriers; and (ii) switching and terminal carriers. Local linehaul describes the movement of trains between

terminals and stations on the main or branch lines of the railroad, exclusive of switching movements. These railways often provide limited services which have been dropped by Class I railways, so we expect these railways to be less connected to other Class I carriers. Finally, switching and terminal railroads are companies that perform switching services for larger railroads. They can also furnish terminal trackage, bridges or other facilities such as union freight stations, operating ferries. They may also perform a combination of these functions. Some regional and local railroads may also operate regular passenger services.

Currently, Canada has two Class I railroads with networks stretching from coast-to-coast.[3] The majority of small Canadian railroads fall into the local railway category. Another (OmniTrax) serves as a regional railway. With few exceptions,[4] smaller rail carriers need mainline track access to successfully complete transportation transactions to their customers. For an export dominated industry like grain production, transparent main line access will be a prerequisite for short line success.

Unlike many parts of the U.S., Canada's Class I railways are not located in close proximity in very many areas. Like many of Canada's transportation networks, the railways are predominantly linear in shape, as they follow a basic east-west linkage. Consequently, there are few places in Canada where the two mainlines are physically connected to each other; very few rail segments in Canada exist that are not physically captive to just one Class I railway. Contrast this situation with the connectivity of the rail network in the United States. The U.S. rail network is far more multi-nodal, with extensive connections on numerous individual segments possible in both east-west and north-south directions.

Geographic constraints virtually guarantee that there will be market power issues on the part of the main lines if the policy of encouraging growth in the narrowly defined short line industry is pursued in Canada. But how serious might this problem be? Data on short lines in the U.S. will be used to determine those characteristics that are associated with the financial success of short line rail carriers in a larger rail market. The conclusion of the analysis is that the positive experience with short lines in the U.S. will not map onto the existing Canadian policy framework.

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[3] Canadian National is now the only railroad in North America with access from "sea-to-sea" and the Gulf of Mexico with their recent takeover of Illinois Central Railroad.

[4] New Brunswick Southern Railway is owned by the Irving Corp. The railway is part of a larger integrated multi-modal transportation network operated by this firm.

Captivity And The Nature Of Network Goods

The American data on short line rail

Several studies have indicated that in order for a short line to be viable, it has to possess adequate demand density and must have more than one connection to a major Class I railroad for access to the larger network (Prater and Babcock, 1998). Avoiding captivity is a viable strategy for many smaller American railroads; the structure of the U.S. rail network is such that in many states, railroad segments have access to at least two railroads. We believe that the success of the American short line experience hinges on this last point.

Rail connection data for U.S. short line carriers from the years 1983 (early post-deregulation) and 1996 is shown in Table 1. This connection data allows us to assess the importance of the captivity problem for smaller rail carriers. In particular, the following question can be asked. Are the majority of successful short line operations in the U.S. avoiding the captivity/bottleneck problem by operating track segments whereby they possess connections to at least two Class I rail carriers?

Table 1. Connectivity of U.S. Short line Railways to Class I Carriers

Type of Railway	Total in U.S.		Per Cent Connected to at Least Two Class I carriers	
	1983	1996	1983	1996
Regional	17	33	82	94
Linehaul	154	232	38	31
Switching	75	128	53	48

While these results are preliminary, Table 1 appears to confirm that much of the success in the U.S. regional railway market can be attributed to the degree of connectivity the short line has to other rail track. We conclude that under the present regulatory structure, few (if any) short line rail operations will be viable in Canada. The U.S. data appears to indicate that a short line industry in Canada will only be viable with alternative competitive regulations like bottleneck pricing or improved access regimes.

The U.S. experience with short lines shows us that in a rail abandonment environment similar to that which exists at present in Canada, financial success for a short line railway is predicated on connectivity to more than one Class I railway. Since this condition does not exist for very many branch lines in Canada, maintaining the present regulatory conditions for line abandonment will very likely result in few successful short line operations, especially on the Prairies.

As we shall discuss in the next section, the problem of short lines is one of recognizing that financial viability is not equivalent to social desirability. Some financially dubious branch lines may have social benefits which cannot readily be captured by a private operator. In this case, extended government intervention may be justified in order to save a branch line from closure.

The next section explores a set of branch lines in west-central Saskatchewan that would likely fail a financial viability test. However, these particular rail lines appear to offer substantial social benefits. One of the most obvious benefits from saving these branch lines is reduced road damage from the increased trucking associated with abandonment. Intervention by either government or special short line interest groups may be justified in these cases.

4 - MEASURING THE ECONOMIC IMPACTS OF BRANCH LINE ABANDONMENT

Introduction

With the passage of the Canada Transportation Act (CTA) in 1987, Canadian Class I railroads were finally given increased freedom to abandon unprofitable branch lines in order to consolidate their network operations. These freedoms were extended in amendments to the Act in 1995. Since 1996, each railway has increasingly pursued a policy of rail line abandonment across the country, often drawing public ire at the speed and finality of their line abandonments (Estey, 1998).

While the details of Canadian abandonment regulations are controversial, the policy is not without direct cost to the railways. Aside from the need to make public notice well in advance (3 years in some cases) of those branch lines under consideration for abandonment, the railways also pay direct compensation costs to communities affected by the loss of rail service. As of the present, this fee is $10,000 per mile or roughly $6,000 per kilometer of abandoned line.

Complicating the process are accusations that the railways have behaved in a manner so as to make it difficult for affected parties to put together any opposition to proposed abandonments. The Estey review of 1998 made public some of the feelings held, especially in western Canada, that the railways were not following "the spirit" of the abandonment rules. Furthermore, several recent abandonment hearings have been controversial. The entire process is under a moratorium at present until the latest round of the CTA review is completed (CTA, 2000).

In this section, we analyze the economic effects of the existing abandonment regulations on the GHTS. We find that under the present Canadian system of abandonment, railway induced abandonment will approach a least cost system for transportation. However, abandonment will transfer significant costs from the railways to farmers and the road network. These social costs ignore capacity utilization in grain handling. If the cost saving from further elevator consolidation is considered, then even fewer branch line rail operations would be viable when considered from a total cost perspective.

Clearly, short line rail will only be financially viable if it can attract enough paying traffic to cover operating costs. Given that the social benefits of reducing road costs and farmer trucking costs cannot be readily captured by the short line operator, the criteria of financial viability for a short line railway will be more difficult to meet than the social desirability criteria.

Under the present regulatory environment, the social objective cannot be achieved unless the short line can operate at costs lower than the equivalent Class I operator on the branch line. In the latter case, the branch line has the advantage of economies of scale and (to a limited extent) scope. Another consideration for any purchase of a branch line is that corridors are initially very difficult to construct. The continuous smooth connection of branch lines into a mainline network is an asset which is worth more than the sum of its parts; that is the nature of scope economies. The decision to sell parts of the line is irreversible and this has to weighed against the option value that will be given up.

As for other players in the GHTS, grain companies will find it difficult to invest in facilities if the future of a short line is uncertain. This uncertainty is another major barrier to the viability of short line railways. Moreover as mentioned in Sections 2-3, without an improved access regime the potential for a hold up problem between a short line operator and a Class I railway is very real.

The Model

We use a spatial equilibrium simulation model of the GHTS to study the impacts of branch line abandonment in a portion of the Western Canadian grain market. Further information about the structure of the simulations is contained in Khakbazan et al. (1999). The key to the model is that it incorporates cost characteristics pertaining to critical elements of the GHTS. The model illustrates the optimal behavior of farmers and the railways through the interaction of their cost relationships.

The simulation model incorporates five assumptions, all intended to make the analysis tractable. In no particular order, these are:

(a) Farmers are rational profit maximizers.

(b) Grain producers maximize their returns by hauling grain to the elevator offering the highest price net of transportation. Grain production has an increasing marginal cost and a fixed proportion of grain production is hauled to elevators. Farmers respond to changes in grain prices by producing more or less grain. A fixed proportion of this grain volume is shipped to export destination.

(c) The trucking industry is competitive; costs are a linear function of distance.

(d) The railways are rational profit maximizers, but are subject to a regulated freight rate structure.

(e) Elevator companies have no market power. They play a passive role in the grain handling and transportation system and charge a tariff irrespective of changes in branch line configuration and volumes handled. This means that there are only two active players in our

model, the farmers and the railways. When a branch line is abandoned, all the grain elevators located on that line will be closed. The grain is redirected to open elevators on other lines.

The model is solved in the following manner. First, we identify the total number of elevators and farms (townships) in the region. Second, we estimate the distance between each farm (approximated as the center of the township) to all elevators. A simple trucking cost equation allows us to compute the trucking cost for each farm to different elevators.

Additionally, we assume that the elevation charge (*EC*) is the same for all elevators, and that farmers deliver their grain to the nearest elevators. Next, we compute the predicted market or catchment area for each elevator and its respective delivered output. Comparison of the predicted delivered output with the actual output received by the elevator yields a residual. By changing *EC* for each elevator, this residual is minimized and the catchment area for the elevator re-estimated. The basic catchment area computed in this manner is then used to analyze the impact of various transportation policies.

Grain Production Costs

A quadratic functional form is used to describe the grain production cost equation:

$$C_G = a + bt^2$$

This function yields the following average and marginal costs:

$$AC_G = \frac{(a + bt^2)}{t}$$

$$MC_G = 2bt$$

where C_G is the total cost per square kilometer of grain production, AC_G is the average cost of grain production per tonne, MC_G is the marginal cost of grain production per tonne and t is the yield in tonnes per square kilometer. The grain supply curve for this cost function is illustrated in Figure 2. Note that for any price less than $\bar{p}$, production would equal zero.

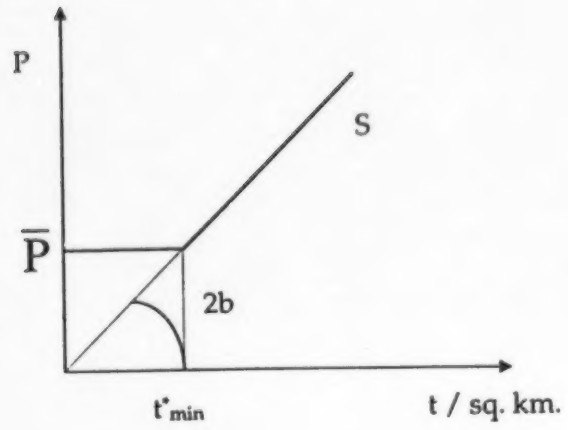

Figure 2. Grain Supply Curve.

Elevator decisions

The decision of grain companies with regard to elevator closure is a complicated one. Grain companies compete for grain business and as a result they have incentives to not close elevators in an effort to maintain market shares. At the same time, there are cost savings to be had from elevator closure. If the companies are constrained by branch line abandonment, then costs cannot fall as much. These two lines of reasoning would yield different cost effects on the system. Since the magnitude and direction of elevator decisions within our modeling framework is not clear, grain elevator decisions are assumed to have zero effect in the simulations. As well, elevators continue to charge the same elevation charges (*EC*) at each point that is on an active rail line.

Farm To Port Transportation Costs

The total freight and handling cost faced by a producer shipping a tonne to port via a particular shipping point to port is the sum of the trucking costs, the elevation costs *EC*, and rail freight rates from the shipping point to port. The net price received will be the common port price minus the transport costs or

$$P_n = P_w - f_r - EC - gd$$

where P_w is the common port price of grain, f_r is the freight rate *EC* is the elevation costs, VC_T is the variable cost per tonne, g is cost per tonne-kilometer, and d is the distance between the farm and the country elevator in kilometers. The farmer will pick the shipping point offering the highest price net of these charges. The cost of grain delivered at the elevator depends on the farmer's location from the elevator, elevation cost, and rail freight rates.

Individual farmers are assumed to choose their quantity of grain production t. Their goal is to maximize profits such that the following relationship between yield and distance is satisfied;

$$t = \frac{(P_w - f_r - EC - gd)}{2b}$$

where P_w is the world price of grain, f_r is the freight rate, and t is the production tonnes per square kilometer of the profit-maximizing farmer located d kilometers from the elevator. This relationship holds as long as t is greater than the shutdown point, t^*_{min}, where the net price is sufficient to cover some of the fixed cost of production.

Railway Branch Line And Main Line Costs

The average cost of transporting grain from the country elevator to the port is the sum of three separate costs: mainline cost, volume-related branch line costs, and line-related branch line costs. Volume-related costs vary with traffic and consist of two main components: (a) service units, defined as measures of the amount of work done; and, (b) unit costs, which are determinations of the standard dollar amounts to be applied to each unit of work performed.

Volume costs are calculated by multiplying service units by unit costs. Volume-related costs are derived from train-related and car-related workloads. These are incorporated into the movement of cars being costed. Line-related costs are fixed and are present on branch lines regardless of traffic level and can be avoided only if the line is abandoned. These costs consist of track and roadway maintenance, depreciation and cost of capital (i.e. ownership), and property taxes associated with the line.

Total railway branch line costs (TRBC) and total railway main line costs (TRMC) are computed as follows.

$$TRBC = i(L_{NW}) + v\sum_{m=1}^{M}\sum_{j=1}^{n} D_{jm}Q_{jm}$$

$$TRMC = \varphi\sum_{m=1}^{M} L_m^p Z_m$$

where φ is the mainline volume-related cost of transporting grain per metric tonne, i is the branch line line-related maintenance cost per kilometer of grain-dependent branch line, v is the average volume-related cost of transporting a tonne of grain over a kilometer of grain-dependent branch line, D_{jm} is the distance on the branch line from elevator j to connection point m, Q_{jm} represents grain moved from elevator j to connection point m, L_m^p is the length of the main line from connection point m to the port, L_{NW} is the total length of the branch line

network, and Z_m is the amount of grain shipped on the main line from connection point m to the port. These costs make up the total railway cost (TRC):

$$TRC = TRBC + TRMC = i(L_{NW}) + v\sum_{m=1}^{M}\sum_{j=1}^{n} D_{jm} Q_{jm} + \varphi \sum_{m=1}^{M} L_m^p Z_m$$

where:

$i(L_{NW})$ represents the total fixed cost (TFC), and $v\sum_{m=1}^{M}\sum_{j=1}^{n} D_{jm} Q_{jm} + \varphi \sum_{m=1}^{M} L_m^p Z_m$ is the total variable cost (TVC).

Note that any adjustment in the length of branch line could affect the railway costs and thus could affect market equilibrium. In sum, even though the form of the cost function is simple, we believe it provides an effective means to examine the consequences of changes in the branch line network.

The study region

The geographic area utilized for the simulation analysis is located in the west-central portion of the Canadian province of Saskatchewan. It contains about a quarter of the total farmland in the province. All three major soil zones - Brown soil Zone, Dark Brown Soil Zone and Black Soil Zone - are found within the region. There are 540 townships (six mile by six mile area) and 90 delivery points located in the region. The area is bounded on the west by the Alberta border, on the north by the North Saskatchewan River and on the south and east by the South Saskatchewan River. This aspect of the geography of the region means that much of the grain movement is confined to a few bridges. Hence, we ignore inter-regional farm to elevator movement except for the areas close to the bridges. The vast majority of the rail movement transports grain out of the region.

This region was chosen because it is representative of a typical grain producing area in Western Canada. Approximately 4,360,000 tonnes of grain per year is produced in the area (as of 1995). Historically about 75 percent of this production is destined for export markets (Saskatchewan Highways and Transportation, 1992). The rest stays in the region for processing and other uses.

In this part of Canada, the vast majority of all export grain is shipped through the West Coast by rail. Therefore, we use Vancouver as the only export destination. Both of the major Canadian railways serve the study region. Main lines belonging to each railway cross the region east to west. And a network of branch lines connects the country elevators to these mainlines. In general, the Canadian National Railway (CN) system serves the northern part of the area and the Canadian Pacific Railway (CP) system serves the south.

To keep the analysis tractable, we identified an important sub-set of thirteen branch line segments for detailed study. These segments carried a total of 2,194,900 tonnes of grain products (as of 1995), through a total of 62 delivery points.

Computing base rail and road costs

The rest of the data used in this analysis came from a variety of sources. These include Saskatchewan Highways and Transportation reports and crop insurance data, along with data from various grain industry officials. The majority of the data incorporated into this study were obtained from the Geographic Information System (GIS) database maintained by Saskatchewan Highways and Transportation.

To estimate road damage costs, we use Saskatchewan Highways suggestion that the annual maintenance cost for grain movement averages out to 3 cents per tonne kilometer for the province. This cost, multiplied by the distance from the geographic center of the township to the delivery point and by the relevant production volume equals the total road cost for a particular township.

Estimated per tonne-kilometer costs for the rail network were considered using coefficient estimates provided to us by the railways. Where data existed for comparison, the calculated costs were very close to actual per tonne-kilometer costs quoted by CP Rail. For example, CP Rail estimated the *Lloydminster* subdivision per tonne-kilometer cost to be equal to $0.074. This is very close to the $0.079 estimated by the model. Similarly, the reported cost of $0.35 for the *Dodsland* subdivision is very close to our estimate of $0.37.

Policy Simulations

The objective of the simulation model is to predict the effects of alternative policies on the railway's profit maximizing behavior. The first task is to simulate the base case scenario or the status quo of the grain handling and transportation system. The initial step consists of calibrating the catchment area for the delivery points located in the study region. We began this process with a $10.89 per tonne elevation cost for each delivery point.[5] Calibration was achieved by adjusting the elevation charges at each delivery point so that deliveries predicted by the model more closely matched actual data with each iteration. Using this method, we achieved a difference of less than 10 per cent between the actual delivered volumes (1994-1995) and the volumes generated by the model. The calibrated model (status quo) was then used to simulate the effects of different policies with a particular focus on railway decisions and reactions.

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[5] This tariff is what AgPro Grain charged for wheat shipped in the 1995-1996 crop year.

The simulations of interest show us the system-wide effects of two policies that directly impact railway behavior. Figure 3 helps to illustrate how the simulation outcomes are organized in the paper and also summarizes the basic simulation results. The scenarios we chose to focus on are:

(a) Branch line abandonment with no penalty. In this scenario, the railways can freely abandon undesired branch lines, and they each do this so as to maximize profits. We formulate two further sub-scenarios incorporating different assumptions about strategic behavior on the part of the rail companies; the two railways can either cooperate or not cooperate in the process of abandonment. The outcomes of these simulations are discussed in the next section.

(b) Branch line abandonment with penalty. In this scenario, the railways can still abandon undesired branch lines, but we assume they are penalized by government for abandoning these lines (we impose a fee of $6,000 per kilometer of line abandoned). Again we formulate two sub-scenarios under this assumption; either cooperation or non-cooperation between the railways in this process of abandonment. The outcomes of these particular simulations are discussed in the Scenario 2 section below.

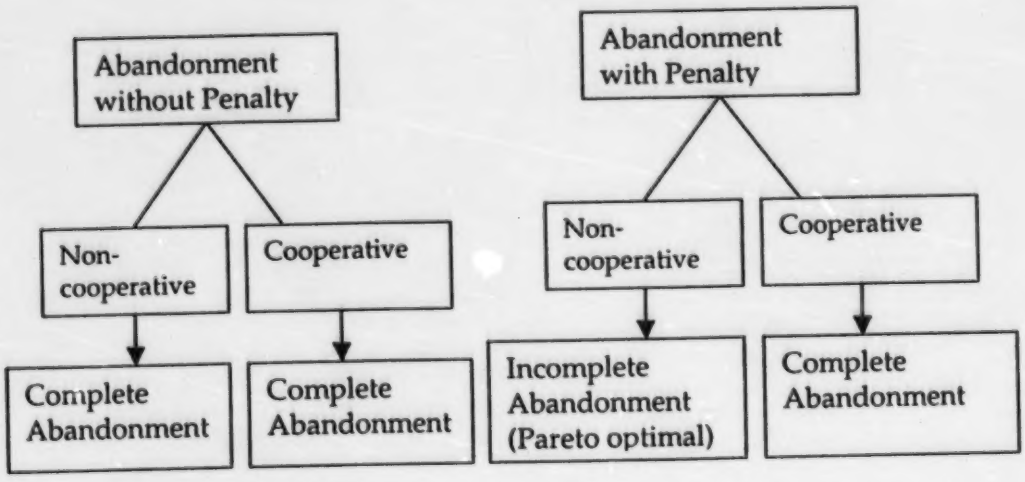

Figure 3: Modeling railway behavior in the context of branch line abandonment.

General Simulation Results And The Cost Incidence Of Abandonment

Combinations of the branch lines were discontinued or "abandoned" in the model and the results tracked in order to analyze the impact of these actions on supply response. It is important to reiterate that in calculating the relevant responses, freight rates were assumed to be regulated and capped.

Our findings indicate a relatively small decrease in grain exports attributable either to the decrease in farm prices or the increase in transport costs as a result of branch line abandonment. The change in production is not very significant. Obviously, rational responses on the part of the farmer would include a shift away from lower valued crops to higher valued commodities.

We consider further the following special cases of interest:

(a) An extreme situation where all branch lines are abandoned;
(b) A more realistic scenario where all branch lines are abandoned except for three higher volume lines (we chose *Kerrobert* subdivision (CP), *Maclin* subdivision (CP), and *Rosetown* subdivision (CN)).

In (a), the farmer's total transportation and handling costs increase by 6.67%. Road costs increase by a 253.9%, and railway costs decrease by 24.39%. The overall cost saving in this case is $2.27 million. In (b), the farmer's total transportation and handling costs increase by 1.38%. Road costs increase once again, but this time only by 70.76%. The railways costs decrease by 11.19%. The overall cost saving in the second scenario is $5.24 million. These results are summarized in Figure 4.

In sum, even though the railways gain the greatest saving in the first scenario, a socially optimal situation obtains where the three high-volume branch lines remain open. The cost saving under the two scenarios is small, but from a social welfare perspective, scenario (b) is definitely Pareto improving. Thus, without a penalty for branch line abandonment, the railways will abandon too many branch lines compared to what is socially optimal.

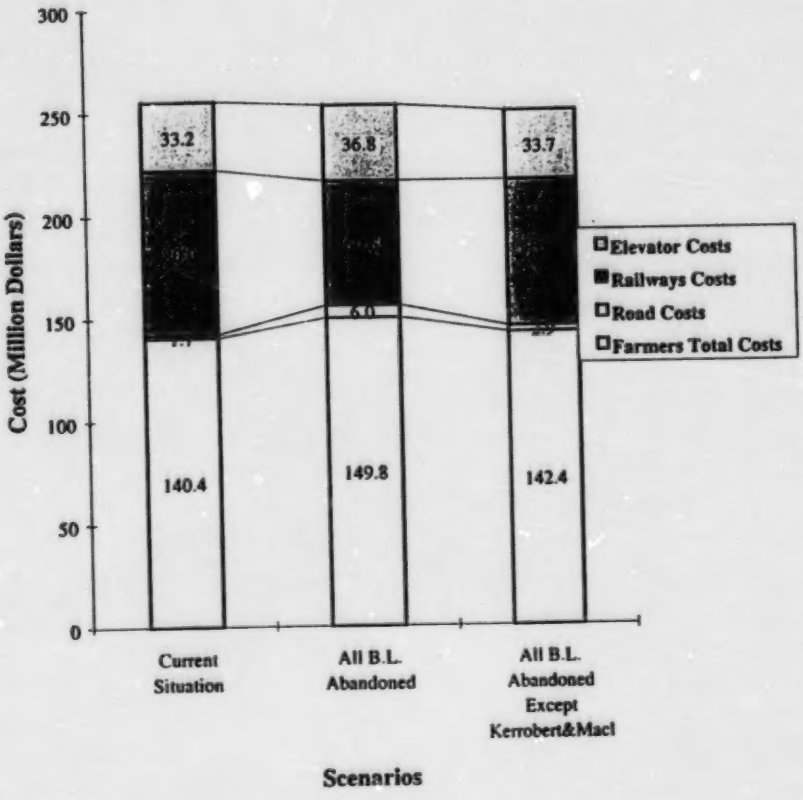

Figure 4. Cost Incidence of Branch Line Abandonment.

The Issue Of Elevator Costs

As is evident in Figure 4, elevator costs increase in some abandonment scenarios. This outcome does not correspond to economic intuition. The reasoning for the results is as follows. When the catchment areas were calibrated, elevation charges were adjusted in the model to minimize the differences between the actual and predicted grain volume in the region. This adjustment caused charges to increase for some of the elevators. Adjusted rates were kept fixed in the model, even with branch line abandonment. But when a branch line is abandoned, the grain volume transferred to remaining elevators should create some economies of size and more intense competition among grain handlers. If in the calibration process, the elevation charges of elevators in new lines have increased, this generates the higher elevation costs.

If elevator consolidation is concurrent with branch line closure, elevation costs would be expected to decline rather than to increase, creating an additional cost saving to the system. We acknowledge that the results are somewhat

compromised by one of our tractability assumptions. However, we believe that the basic cost results are correct.

The last issue left to examine is how the two railways might abandon the branch lines in the region. In effect, this is the question of market arrangement. Using this particular set of assumptions, CP earns $5,587,564 in profits and CN earns $3,843,249 of profit from the branch lines in the region. They also extract $8,854,393 and $13,871,299 profits on both the main and branch lines respectively. We now report on results when changes in railway behavior are incorporated into the simulations.

Modeling railway reactions to policy changes: Branch line abandonment without penalty (Scenario 1)

Strategic railway behavior in the process of branch line abandonment implies that two outcomes are possible. Figure 5 summarizes the basic results.

(a) The non-cooperative case. We assume that when the rail companies abandon branch lines, they consider only their own profits. We studied a few scenarios representing this case - for instance, when the *Bodo* subdivision of CN was abandoned, or when the *Smiley* subdivision of CP was abandoned. An extreme example of this could occur if CN decided to abandon the subdivision of *Bodo* and CP decided to abandon the subdivisions of *Smiley, Kerrobert, Major, Reford, Maclin* and *Lloydminster*. This leads to another important issue which will not be considered further here: would one rail company let the other company benefit more from its decision toward abandonment? Study of this question is left to further research.

(b) Cooperative case. Here, we modify the simulation model by assuming the two rail companies collude to maximize profits. As expected, the profits of each railway are maximized when all the branch lines in the region are abandoned.

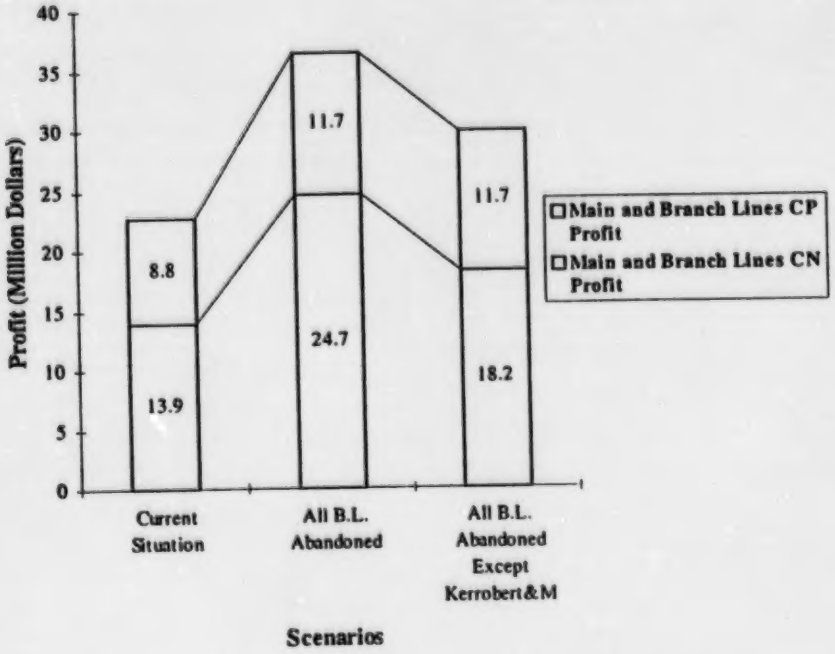

Figure 5. Distribution of Branch Line Profits, No Penalty for Abandonment

Branch Line Abandonment With Penalty (Scenario 2)

Figure 6 shows branch line profits in the case where the railway is penalized for abandoning branch lines. We assume here that the railway has to pay a fee of $6000 per kilometer of line abandoned. This amount is very close to the actual amount charged to the rail companies for abandonment under CTA (CTA, 1999).

The conclusions made in the previous section can be extended to this case. In the scenario where the railways independently maximize profits, all the branch lines except *Kerrobert* subdivision, *Maclin* subdivision, and *Rosetown* subdivision were abandoned. However if the two railways cooperate to maximize their joint profits, all branch lines will be abandoned.

When the railways do not collude, imposition of the penalty on abandonment results in the least cost (socially optimal) branch line configuration. Re-stated, our simulations show that a scenario closely approximating the actual policy chosen by the Canadian government towards rail abandonment under the CTA yields the Pareto optimal result.

Conversely, we find that if the railways are able to collude in order to maximize their joint profits, then complete (and socially excessive) abandonment takes place. Thus our simulations show that railway behavior matters when

considering whether or not actual abandonment policy in Canada works in practice. Considering the relative freedom given to the railways at present to pursue abandonment, it is very likely that there are non-trivial costs being borne by society because of the present form of abandonment policy. This leads us to consider that some form of further regulatory oversight may be necessary on the part of government in order to guarantee that social welfare is optimized with respect to branch line abandonment.

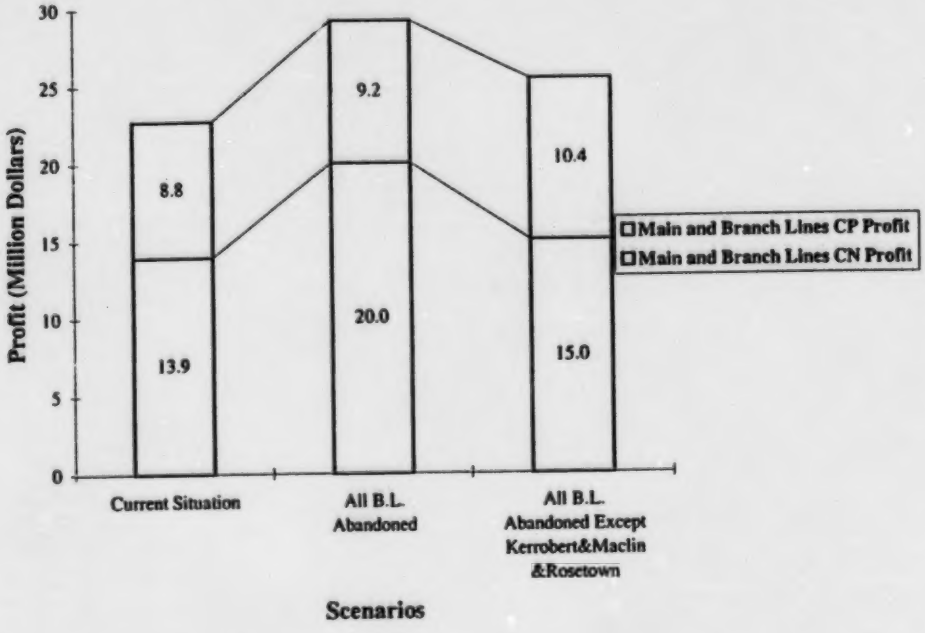

Figure 6. Distribution of Branch line Profits, Penalty for Abandonment.

Sensitivity Analysis

We chose three variables for further study in our sensitivity analysis. These variables are trucking cost, elevation cost, and railway volume-related cost. We chose the latter because foreseeable technological improvement in the railway industry will be reflected in lower volume-related costs. Conversely, line-related costs are very unlikely to be affected in near future.

Change in trucking costs

Recall from the trucking cost function that trucking cost was assumed to be eight cents per tonne/kilometer, on average. In this simulation, we examine the overall impact on the grain handling and transportation system of lowering the trucking cost from eight cents to six cents. Our results suggest that a reduction in trucking cost generates more grain production and more export, though the impact is not significant. We also find that as a result of reductions in trucking cost, the change in the distribution of delivered grain is quite significant.

As trucking costs decrease, the average cost of those branch lines that receive increased grain volume will decrease. Thus, lowering trucking cost from eight cents to six cents causes abandonment of higher cost branch lines and creates more traffic on lower cost branch lines. Our figures also indicate that a reduction in trucking cost reduces the socially optimal number of branch lines and in turn facilitates more elevator consolidation. It also induces the distribution of profit on branch lines to change for both railways.

Formally, our simulations show that a reduction of two cents per tonne/kilometer in trucking cost reduces farmers costs from $140.4 million to $139.3 million, reduces railway costs from $80 million to $78.8 million, and reduces elevation costs from $33.2 million to $32.1 million. Road costs increase from $1.7 million to $2.3 million. These results are obtained under the assumption that road costs remain the same at three cents per tonne/kilometer and that road use increases (Table 2). It is interesting to note that a switch to more efficient trucking would lead to a system cost saving of $2.8 million. Taxpayers are the most affected with $0.6 million more road costs, as well as the lost of property taxes on the abandoned rail lines.

Table 2. Cost Analysis in the Grain Handling and Transportation System When Trucking Cost Decreases from 8 Cents to 6 Cents per Tonne-Kilometer (Millions of Canadian $).

Scenarios	Farmers Total Cost	Road Cost	Railways Cost	Elevator Cost	Total Cost	Total Cost Saving
Current Situation (8 Cents Trucking Cost)	140.4	1.7	80.0	33.2	255.3	2.8
New Situation (6 Cents Trucking Cost)	139.3	2.3	78.8	32.1	252.5	
Change	1.1	-0.6	1.2	1.1	2.8	

Table 2 compares the distribution of benefits of the base-case scenario (eight cent trucking cost) with the new scenario (six cent trucking cost).

Change in both elevation charges and trucking costs

In this scenario, the trucking cost was lowered in the same manner as in the previous section, but this was combined with a ten percent reduction in elevation rates. The total volume of export increases to 3,211,621 tonnes compared to 3,189,823 tonnes in the base case (1995). The configuration of branch lines was similar to the previous simulation, but the distribution of received volume was altered slightly among the delivery points. The branch line average costs declined for the lines that received more grain.

Table 3. Distribution of the Branch Line Profits as a Result of Change in the Trucking Cost (Canadian $).

Subdivision	Current Situation (8 Cent Trucking Cost)	New Situation (6 Cent Trucking Cost)
LLOYDMINSTER	1,968,818	2,274,296
BODO	-365,201	0
MAJOR(Coronation)	70,287	85,270
REFORD	99,913	-134,451
SMILEY(Dodsland)	-164,105	-194,943
CONQUEST (Top)	433,149	370,108
MATADOR	-195,851	-175,280
W.BEAR	-196,684	-282,450
MANTARIO	-372,387	0
ELROSE	1,288,010	1,412,039
MACKLIN	2,455,937	3,199,725
KERROBERT	1,156,714	927,074
ROSETOWN	2,722,196	3,288,682
CONQUEST	530,017	378,441
Branch Lines CP Profit	5,587,564	6,156,972
Branch Lines CN Profit	3,843,249	4,991,539
Main and Branch Lines CN Profit	13,871,299	15,198,233
Main and Branch Lines CP Profit	8,854,393	8,709,060
Total Main and Branch Lines Profit	22,725,692	23,907,293

In total, there is a $4.7 million cost saving under this scenario compared to the base case. Farmers, railways, and elevators all benefit as a result of this change. The only losers in this scenario are taxpayers.

Change in railway volume-related cost

Some authors have argued that during the WGTA era in Canada the railways captured roughly half of their cost savings from technological advancements and productivity gains (Vercammen, 1996). There is growing evidence that with the elimination of the WGTA, the railways now capture an even larger share of the productivity benefits, to the detriment of shippers (Vercammen, 1996, PRR Consulting, 1999). Under the present regulatory policy environment, the railways are very likely to aggressively seek out cost-efficient technologies (see Gallamore, 1999)

In this final sensitivity analysis, we represented technological gain by a lower railway volume-related cost. In all previous simulations, the railway volume-related cost was assumed to be 1.2 cents and 1.8 cents per tonne-kilometer for the main and branch lines respectively. Here, these costs were lowered to 1.0 cent for the main line and 1.5 cents for the branch lines. All other variables were assumed to be the same in order to focus on productivity gains.

If we assume that the railways receive half of the productivity benefits from improvements in rail technology, we find that the two railways collectively gain $6.11 million annually as a productivity benefit in the study region alone. Thus, our simulation verifies that under CTA, the railways possess extremely strong incentives to seek out more cost-efficient technologies in whatever way they can. This is especially true with respect to the movement of grain across western Canada.

Conclusion

We used a simulation model of the western GHTS to examine the impact of branch line abandonment in Saskatchewan on supply response and costs for railways, farmers and roads. We found that the increase in transport costs as a result of line abandonment caused a relatively small decrease in grain production. The overall impact of abandonment is a loss of social welfare, increased road costs, and large proportional benefits to the railways.

Within the study region, we found that the least-cost rail configuration occurs when certain branch lines remain open. As expected, this socially optimal configuration was different from those scenarios focusing solely on the best interests of the railways; railway profits are maximized with a complete abandonment of branch lines.

The difference in total efficiency gains between a complete abandonment as compared to a partial abandonment was relatively small. Depending upon firm behavior, a $6,000/km abandonment penalty can reduce the railways incentive for abandonment. We found that if railways do not make their abandonment decisions collectively, this penalty would result in the socially optimal level of abandonment. What is most interesting is that this particular policy corresponds quite closely to the actual penalty for abandonment under the CTA.

Conversely, if the railways collude and maximize joint profits, it would be in their interest to abandon all branch lines even with the penalty in place. These results lead us to conclude that increased regulatory oversight on railway behavior with respect to abandonment may be justified. The present CTA review process has temporarily delayed further branch line abandonment. If present abandonment policies are not changed, in another 1-2 years it will be too late to forestall virtually complete abandonment of branch lines in Western Canada.

Modifying other parameters in the simulations show that moderate changes in trucking and rail costs yield a surprisingly wide range of results. We find that a cost-reducing technological advancement in the trucking industry leads to significant redistribution of benefits among the parties involved in grain transportation. However if we consider the present regulatory regime, our

results indicate that the railways will benefit most from cost-reducing technological improvements in the grain handling industry in relation to the other affected parties.

Finally, extending the present results would require an explicit consideration of competition for a short line from rival railways. If short line traffic moves on to the mainline of railway A then railway B can use some form of incentive rates to discourage this movement. This may adversely affect the market share of the short line and discourage its use. From the decision-making perspective, these costs also have to be considered in assessing the desirability of branch lines.

5 – THE EFFECTS OF ABANDONMENT ON TRANSPORTATION COSTS IN THE GHTS

Introduction

The province of Saskatchewan was developed and settled on the basis of a grain farming economy. The province was surveyed by the time of major immigration to the west. The allocation of this land to the new settlers for farming purposes was responsible for sparse location patterns across the province. To support this spatial arrangement both for the grain economy and day-to-day use, the province designed and built an extensive grid network of roads. Not surprisingly, Saskatchewan possesses the highest road mileage per capita in North America (Government of Saskatchewan, 1999).

Even without changes to the grain economy, this road network has been costly to maintain. In fact, the grain handling and transportation industry uses multiple modes to get grain harvested on the farm to export position. Today, as the system for storing grain consolidates into a network of a few high-throughput elevators, more producers are located further away from these collection points. While rail will continue to be an important part of this process, recent regulatory changes in the GHTS have placed increasing emphasis on trucking and the road network in Saskatchewan.

Private vs. Social Costs in Trucking

In the 1960s, the average distance traveled by trucks moving grain from farm to elevator was less than 10 miles. However, by the end of the year 2000, extensive branch line rail abandonment by the Class I railways has left many grain producers far from the nearest elevator. The average shipping distance for grain by truck has more than doubled. It is highly likely that the elevator system will consolidate even further over the next few years, with average trucking distances leveling off at a considerably higher level than at present. From an engineering perspective, the road network in Saskatchewan was never designed to handle the increases in truck traffic now associated with the shrinking elevator network.

From a distributional perspective, abandonment of the branch line rail system in the Prairies and the subsequent increase in the use of trucking creates two major impacts on society. Both of these results were clearly identified in the simulation model of the previous section. The first result is that railways gain economies of scope and density when they do not have to internalize the costs of low-volume branch lines. The second is that when these transport costs are not internalized by the railways, they must be borne (in the case of the GHTS) directly by both producers and local and provincial governments. In this section, we will focus on the costs borne by government from the abandonment process.

In the next section, we will analyze recent policy discussions that have focused on road pricing as a way to utilize the rural road network more efficiently under rail line abandonment (Estey, 1998). We will present results of the implementation of an optimal road pricing policy in the same study area of Saskatchewan.

Trucking and externalities in the GHTS

In Canada, the public provision of roads ensures that trucking remains a comparatively low fixed cost and relatively higher variable cost industry as compared to rail. This fact has implications for the GHTS. Low fixed cost and relative easy entry conditions for trucking means that in order to move similar volumes of grain to market under rail line abandonment, there are likely to be socially inefficient (excessive) numbers of trucks on the roads serving the grain industry. While the trucking industry pays taxes as an offset to their road use, it is generally agreed that trucks do not cover their marginal damage (or social) costs to roads (Viscusi et al, 1996). This situation is exacerbated in Saskatchewan when compared to many North American jurisdictions. Road damage costs on a per-km basis are high because of the surface structure of many "thin-membrane" roads in the province.

Theoretically, the overuse of a publicly provided resource such as a road occurs because of a lack of price signals to allocate the resource in an efficient manner. From the perspective of society, rail line abandonment combined with the public provision of roads and the lack of proper prices for road use encourages overuse of roads by grain trucking relative to the social optimum.

Figure 7 illustrates the problem. The demand for trucking is given by the demand curve, while the marginal cost of providing this trucking is given by the two cost curves. One of these curves shows the private costs borne by truckers, while the other shows the total costs of trucking, or the social costs. In addition to the private costs, the social costs including the cost of road damage.

The difference between marginal private costs and marginal social costs measures the level of the externality associated with trucking. The primary externalities associated with truck use in the Prairies are road wear and tear (maintenance).[6] Based on the private costs, the amount of trucking undertaken is Q_1 and the marginal cost of providing this trucking is P_1. Based on the social costs, the desired level of trucking is Q^*. One way of achieving this socially desirable level is to impose a tax of (P^*-P_1) on trucking. This tax would generate a net gain to society of the amount of the triangle-shaped area indicated in the diagram.

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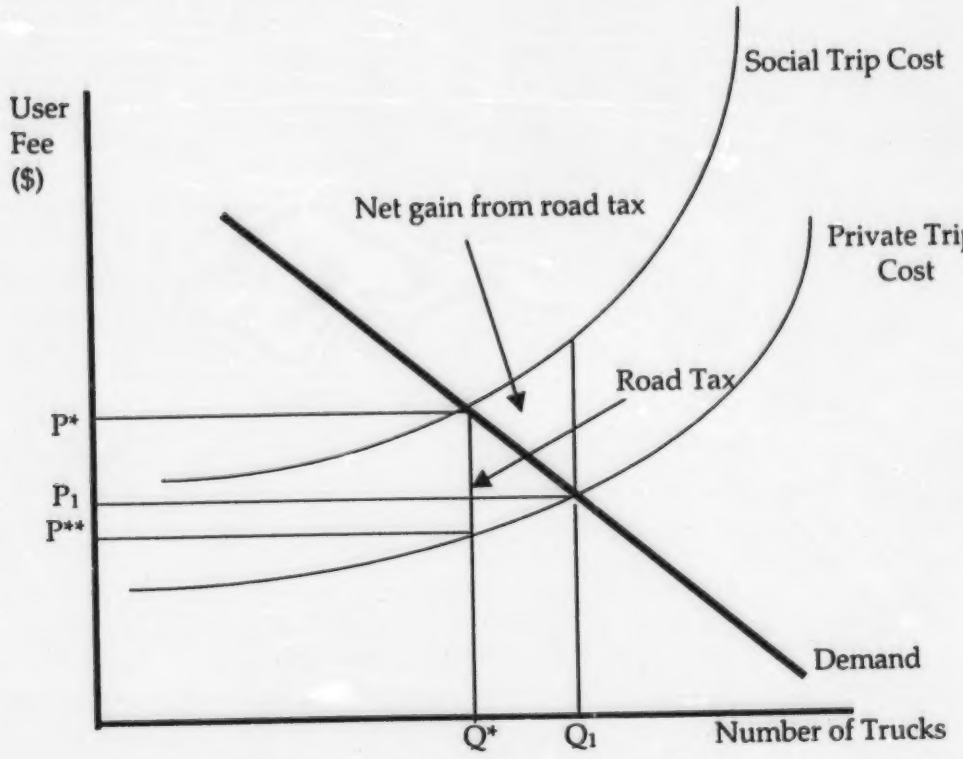
[6] Pollution is an important externality as well, but not as critical to this study.

To help better understand the consequences of branch line abandonment on producers and the road network in Saskatchewan, we will expand the analysis of the last section dealing with the impact of abandonment on trucking. We incorporate a variable road tax on truck movements based upon estimates of road maintenance costs due to increased trucking on the rural road network. This generates an approximation of both the social costs of trucking and the net social gain (the area shown in Figure 7) from the imposition of a tax on trucking in West-Central Saskatchewan. We find that the net gain to society from road pricing is small in comparison to the total costs of transportation in the GHTS. Since a road tax would raise the cost of transportation to farmers, the imposition of such a tax is not likely to be a desirable solution for dealing with the road cost externalities in the GHTS. Other policies suggested elsewhere in this report are better suited to the unique circumstances of the GHTS.

Figure 7. Road damage externalities associated with grain trucking



Assessing the impact of a road pricing policy on the GHTS

Section 4 presented simulation scenarios whereby a set of branch lines in Saskatchewan were abandoned and the resulting system costs were computed. In these scenarios, it was assumed that when short line rail service was not available, affected producers would move their grain to elevator by truck over the existing road network. With increasing abandonments, this reaction implied that more grain was moved longer average distances.

In the GHTS, grain producers have substituted trucking for rail service in many areas. To get a better perspective on the effects and importance of trucking in the modern GHTS, this section will present simulation results of an extreme scenario of total branch line abandonment. Using actual railway forecasts for Prairie rail line abandonment in west-central Saskatchewan, we simulate the resulting trucking flows and compute welfare effects. This is a calibration exercise, as it produces similar results to those for trucking presented in Section 4.

Due to the maintenance damage externalities caused by increased trucking in the grain industry, we further consider a policy of differential road pricing based upon maintenance cost estimates provided by Saskatchewan Highways. Under complete branch line abandonment in the region under study, we simulate producer reaction to a road tax scenario whereby each producer is charged a fee proportional to the distance traveled and the road type used.

Ultimately, we discover that such a road tax does not strongly affect total welfare. The gains to society from differential road pricing with complete rail abandonment are small and the cost to the farmers is substantial. Overall, it appears that society does not gain from moving the cost of grain transportation to producers. This conclusion indicates that there may be a place for regulatory intervention to maintain certain branch lines and delay the abandonment scenarios proposed by the Class I railways.

Road Charges Appropriate To Grain Trucking

In this section, a set of Saskatchewan roads are assigned different maintenance costs depending on road type. Saskatchewan Highways (1992) has defined three distinct road classes, based on construction. These are;

(a) Structural pavements, which range from a thin asphalt seal on a granular surface to a full depth asphalt concrete (approx. 40% of highway system).

(b) Thin membrane pavements are a thin asphalt mat approximately 25 to 50 mm thick placed directly on a prepared subgrade (approx. 40% of highway system).

(c) Gravel is simply a layer of traffic gravel on a prepared subgrade (constituting the remaining roads in the Saskatchewan road network).

With respect to road pricing, these pavement distinctions allow us to readily incorporate differential road user fees depending on the type of road. The road charges used reflect the actual costs for road use based on surface quality; the latter two surface types are more prone to damage from heavy loads. The road costs used for modeling in this section are taken from *1999 Branchline Review* (Rees, 1999), part of the parallel process to the 1999 Kroeger Report. The exact road charges we use here are;

P-class (paved)	$.01325/tonne-km
G-class (gravel)	$.0291/tonne-km
T-class (thin membrane)	$.0873/tonne-km

It is important to note again that structural pavement roads are designed for heavy truck traffic such as that generated by branch line abandonment, but TMP and gravel roads are not designed for this purpose.

The Behavioral Model

The behavioral model assumes that grain producers in the selected region will make deliveries so as to maximize their net returns. Further, all grain production costs are exogenous to this model, so minimizing total handling and transportation costs maximizes net returns. The latter assumption allows us to focus attention on the producer transportation costs within the study region. Thus, the individual producer's profit maximization function can be written as the following (Larson, 2001):

$$\text{Max } \prod = vP_w - vW_e - vW_f - vW_r$$

$$\text{s.t.} \quad W_e + W_f + W_r \leq P_w$$

where P_w is the free-on-board (FOB) price of grain per tonne; the elevator charge $W_e = ve$, where v is the volume of grain handled and e is the charge per tonne handled; the freight rate charge $W_f = vf$, where v is the volume of grain going to port and f is the regulated freight rate to port per tonne; and road charges $W_r = v(gx + ty + sz)$, where v is the volume of grain delivered, g is the charge per tonne kilometre for gravel roads, x is the mileage of gravel roads to the elevator, t is the charge per tonne kilometre for thin-membrane roads, y is the mileage of thin-membrane roads to the elevator, s is the charge per tonne kilometre for structural/granular roads and z is the mileage of structural/granular roads to the elevator.

As constructed, the constraints ensure that producers will not deliver if the handling and transportation costs exceed the FOB price, and the FOB price must

be non-zero. We incorporate a $10.89/tonne elevation cost for each delivery point (see Footnote 5). And as in Section 4, we have also assumed that rail rates are capped from each delivery point to the Port of Vancouver.[7] Since the FOB price and the production volume are given, this model works under the assumption that producers try to minimize the delivery (road and rail) and handling costs they face. Given that the road charges are known, the producer optimization model computes delivery allocation to the elevators based on minimizing road charges.

We assume that grain is exported out of the Port of Vancouver using regulated rates because of the study region's proximity to Vancouver versus the St. Lawrence Seaway in the East. Possible use of the American GHTS system is ignored to keep the analysis consistent with Section 4. If a station had more than one rate to Vancouver, the average rate was taken. A list of freight rates is provided in Table 4.

Table 4. Regulated Rates to Vancouver from grain elevators (Aug. 1, 1999)

Elevator Station	Freight to Vancouver (per tonne/km)
Kindersley	$39.03
Luseland	$33.17
Cutknife	$34.45
Unity	$33.18
Lloydminster	$32.81
Dodsland	$33.82
Biggar	$34.78
Rosetown	$36.43
Dinsmore	$38.39

Source: Canadian Transportation Agency

We apply the behavioral model to the same study region used in Section 4. To minimize assumptions about where producers will truck their grain, we capture a set of possible producer trucking route choices by using three hypothetical (feasible) delivery routes by road from the centroid of each rural municipality to every delivery point. These choices represent feasible routing alternatives for the average producer in each rural municipality (RM).[8] The distance for each of these three possible routes is broken down according to the road type (gravel, thin

[7] While rail rates are no longer capped at each delivery point (with the implementation of Bill C-34 and the revenue cap in late 2000), it is highly likely that rates set in the near future will be well approximated by the distance based rate cap.

[8] As can be seen in Table 5, there were cases where the number of possible routings from RM to elevator was less than three due to the topology of the existing road network.

membrane, or gravel) and the applicable trip cost (according to road type) computed. Table 5 shows road type and distance data from one RM to two elevators.[9]

Due to combinatorial issues discussed below, the study is restricted to the 49 rural municipalities and the nine high-throughput delivery points (with elevators greater than 8,000 tonnes capacity) that presently exist in the study region.

Table 5. Producer delivery options to elevators

Delivery Route	Delivery Point (Elevator)									
	Kindersley					Luseland				
Option	Structural	Granular	TMP	Gravel	Total KM	Structural	Granular	TMP	Gravel	Total KM
1	90.4	36.4	97.8	0	224.6	60.2	36.4	191.0	0	287.6
2	29.5	13.4	155.8	21.7	220.3	130.2	0	167.0	0	297.2
3	9.7	30.0	148.1	23.2	209.9	0	0	0	0	N/A

In order to simulate the timing of deliveries and the effects of elevator capacity constraints, the model was set up to randomly assign delivery order for each RM. Once a municipality was chosen in this manner, the model then assigned all production volume from the RM to the elevator with the least total transportation cost with respect to that RM, subject to capacity. If a given delivery exceeded an elevator's capacity, the delivery was then assigned to the elevator with the next smallest transportation cost for the RM. This process was continued until all the municipalities had completed their grain deliveries. Random assignment of delivery means that with 49 origins, there are 49! possible delivery patterns in this region alone. So in order to keep the analysis tractable, we averaged a set of 1000 different delivery patterns to derive the basic road pricing results.

Results and Summary

Two road pricing scenarios were implemented. The first scenario demonstrates the delivery patterns of producers if a non-discriminatory or fixed road price existed in the study region. We assigned a road charge of three cents per tonne-kilometre for all road types. In fact, this scenario is similar to trucking scenarios presented in Section 4, with the exception here that only existing or pending high-throughput elevators in the region are used. We have also assumed that grain transportation by rail only takes place on main lines. Combined, these two assumptions simulate extensive rail abandonment and elevator consolidation.

[9] The road type and distance data were obtained with the help of Saskatchewan Highways using GIS software.

Finally, we also assume that the seven major crops in the study region are only handled through high-throughput elevators.

The second road pricing scenario uses the exact same assumptions as the first, with the exception that road charges are imposed on the system based upon maintenance costs for each road type. Road charges are intended to modify the trucking route decision made by producers to deliver grain. However an issue of major interest to this study is to examine how a road pricing policy interacts with an environment where short lines are non-existent. Results from the road pricing scenarios on the GHTS are provided in Table 6.

Table 6. Gains in economic surplus with road pricing

Scenario	Total road charges paid by producers	Gain in surplus	% of total system delivery cost
Fixed Road Charges	$6 525 649	$541 880	0.4
Differential Road Charges	$6 742 425	$530 166	0.4

Examining the table, we can see that the magnitude of the road charges is excessive when compared to the gains in total surplus. Furthermore, since total system delivery costs are on the order of $120 million in every case, the gains in surplus from road pricing are indeed small. We conclude that with elevator consolidation and complete rail line abandonment in this area of Saskatchewan, "justifiable" road pricing does improve economic welfare very much.

Such small changes in surplus relative to road pricing revenues confirm that with rail line abandonment, producers in the study region become increasingly captive to trucking. Even with optimized road pricing schemes, the transportation-related behavior of producers will not change. Obviously, a policy of road pricing can help a road network fund and maintain itself, but our findings indicate that in Saskatchewan, this situation would occur directly at the expense of producers who have run out of transportation options.

6 - CONCLUDING REMARKS

Rail line abandonment is a controversial issue. Given its relevance to future rail policy in Canada, this study examines the impacts of abandonment and the viability of short line railways. We also examine current and proposed abandonment policies through the application of relevant economic models.

The hold-up problem and a lack of bargaining power with the Class I railways means that many potential short line railway operators are likely to be reluctant to make the necessary investment in a branch line. Therefore, short line railways may not exist even in situations where they would be economically desirable. Another conclusion that emerges from this analysis is that short lines are more likely to exist when they have multiple mainline railway companies with which to bargain for rail access.

Economic cost simulation models of the GHTS indicate that a short line railway will be economically desirable only if its existence will result in a net reduction in total system costs relative to abandonment. Thus grain dependent short line railways will only be financially viable if they can attract enough revenue traffic to cover their cost of operations. If short line railways are to improve social welfare, they must be able to operate at costs lower than the equivalent branch line, staying mindful that branch lines operated by Class I railways have the advantage of network economies.

Next, we examine the welfare implications of a road pricing policy for grain trucking. Since road costs and farmer trucking costs cannot be captured by the short line operator, the criteria of financial viability for a short line will in general be more difficult to meet than the social desirability criteria. Once again, these factors indicate that there will likely be significant under-investment in branch lines relative to the social optimum.

The overall results indicate that if certain branch lines can be preserved through the establishment of short line rail operations possessing low operating costs, farmers and taxpayers will benefit from reduced trucking and road costs. Therefore where applicable, it is in the interest of these groups to develop institutions and provide sponsorships for short line operations.

While our basic conclusions are widely applicable, this study has not considered all possible issues pertaining to the branch line abandonment issue. One important aspect of the problem we have not explicitly considered with respect to any abandonment or purchase of a branch line is that new rail corridors are very expensive to construct. The decision to abandon sections of rail network is,

for all intents and purposes, irreversible; this fact has to weighed against the option value that will be given up if a line is permanently abandoned.

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